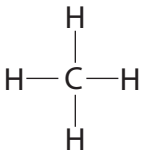
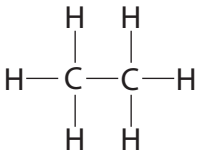
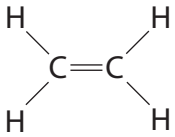
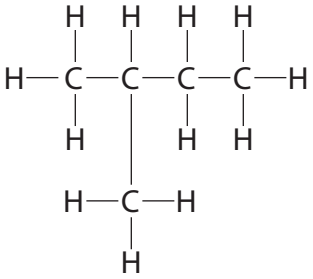
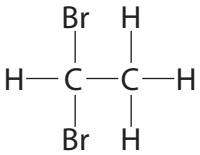
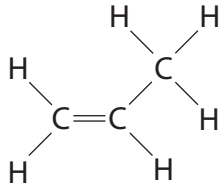
1 The table shows the displayed formulae of six organic compounds, P, Q, R, S, T and U.

P 	**Q** 	**R** 
S 	**T** 	**U** 

(a) (i) What is the molecular formula of compound S?

(1)

.....

(ii) What is the empirical formula of compound T?

(1)

.....

(b) (i) Give the letters of two compounds that belong to the homologous series of alkenes.

(1)

..... and .....

(ii) The general formula of this homologous series is

(1)

☒ **A** C_nH_{2n-2}

☒ **B** C_nH_{2n+2}

☒ **C** $C_n + H_{2n}$

☒ **D** C_nH_{2n}

(c) Which of these conversions is an example of an addition reaction?

(1)

☒ **A** compound P → compound Q

☒ **B** compound Q → compound T

☒ **C** compound R → compound Q

☒ **D** compound R → compound U

(d) Complete the table to show the displayed formula and name of the isomer of compound T.

(2)

Displayed formula	
Name	

(e) The equation represents a reaction between compound P and bromine.



(i) Complete the equation to show the displayed formula of the organic product.

(1)

(ii) State the name of this organic product.

(1)

.....

(iii) State the condition used in this reaction.

(1)

.....

(iv) What term is used for this type of reaction?

(1)

☒ **A** addition

☒ **B** hydration

☒ **C** neutralisation

☒ **D** substitution

(f) Old refrigerators may contain substances that harm the ozone layer in the atmosphere. Many new refrigerators use 152a, an organic compound that does not harm the ozone layer.

152a has the composition by mass C = 36.4%, H = 6.0% and F = 57.6%.

(i) Calculate the empirical formula of 152a.

(3)

empirical formula .....

(ii) The relative formula mass of 152a is 66

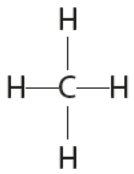
What is its molecular formula?

(1)

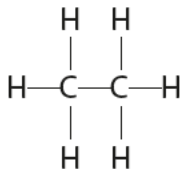
molecular formula.....

(Total for Question 1 = 15 marks)

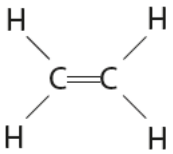
2 The diagram shows the displayed formulae of five hydrocarbons A, B, C, D and E.



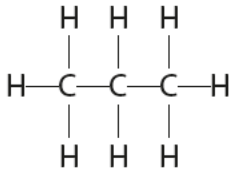
A



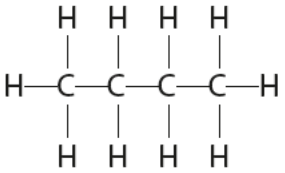
B



C



D



E

(a) Give the letter of a hydrocarbon to answer these questions.

You may use each letter once, more than once or not at all.

(i) Which hydrocarbon is the main component of natural gas?

(1)

.....

(ii) Which other hydrocarbon is produced, together with D, when pentane (C_5H_{12}) is cracked?

(1)

.....

(iii) Which hydrocarbon can undergo an addition reaction with hydrogen to form B?

(1)

.....

(b) Give the molecular formula and the empirical formula of E.

(2)

molecular formula.....

empirical formula.....

(c) Hydrocarbons A, B, D and E all belong to the same homologous series.

(i) Give the name and the general formula of this homologous series.

(2)

name .....

general formula .....

(ii) Draw the displayed formula of an isomer of E.

(1)

(d) Two reactions that can occur when hydrocarbon A is burned in air are represented by these equations.

Equation for reaction 1 $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

Equation for reaction 2 $CH_4 + 1\frac{1}{2}O_2 \rightarrow CO + 2H_2O$

Explain why a different product is formed in reaction 2 and why this product is dangerous.

(3)

.....

.....

.....

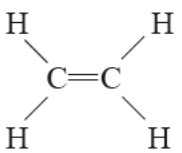
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.....

.....

(Total for Question 2 = 11 marks)

3 A teacher explained the different types of formula used in organic chemistry, using ethene as an example.

Description	Formula
general	C_nH_{2n}
empirical	CH_2
molecular	C_2H_4
structural	$CH_2{=}CH_2$
displayed	

(a) Use this example to help you write the formulae described below.

(i) The empirical formula of methane

(1)

(ii) The molecular formula of ethane

(1)

(iii) The structural formula of propane

(1)

(iv) The displayed formula of butane

(1)

(b) All the compounds in part (a) belong to the same homologous series and have the same general formula.

(i) State the name of this homologous series.

(1)

(ii) State the general formula of this homologous series.

(1)

(iii) State **two** characteristics of the compounds in a homologous series, other than having the same general formula.

(2)

1

2

(c) All the compounds in part (a) are hydrocarbons. They can undergo complete combustion when burned in oxygen to form carbon dioxide and water.

(i) Write a chemical equation for the **complete** combustion of propane (C_3H_8).

(2)

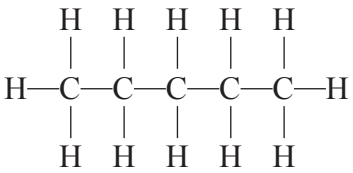
(ii) Identify one solid product and one gaseous product that could form during the **incomplete** combustion of propane.

(2)

Solid product

Gaseous product

(d) The displayed formula of pentane is



Draw a displayed formula for each of the two isomers of pentane.

(2)

Isomer 1 Isomer 2

(e) When methane reacts with bromine, one of the products is hydrogen bromide.

(i) State a condition needed for this reaction.

(1)

(ii) Name the organic product of the reaction.

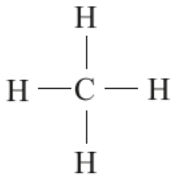
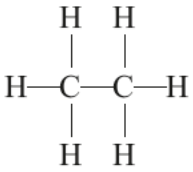
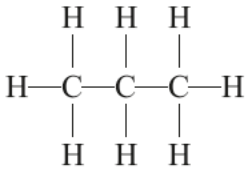
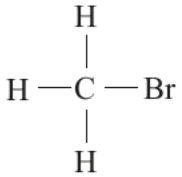
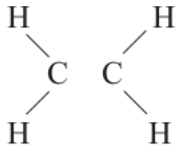
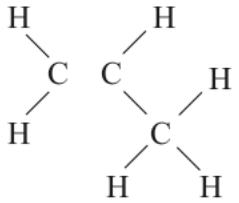
(1)

(iii) Write a chemical equation for the reaction.

(2)

(Total for Question 3 = 18 marks)

4 These are the displayed formulae of six organic compounds.

		
P	**Q**	**R**
		
S	**T**	**U**

(a) Use the letters above to select

(i) the compound that is **not** a hydrocarbon.

(1)

.....

(ii) **one** compound with the empirical formula CH_2

(1)

.....

(iii) **one** compound that can form a polymer.

(1)

.....

(b) Describe a test that will distinguish between compounds **Q** and **T**, and state the observation made with compound **T**.

(2)

Test .....

.....

Observation with compound **T** .....

.....

(c) Draw the displayed formula of an alkene containing four carbon atoms.

(1)

(d) Three of the compounds belong to the alkane homologous series.
All the alkanes in this homologous series have the same general formula.

(i) What is the general formula of the alkanes?

(1)

.....

(ii) State **two** other features of a homologous series.

(2)

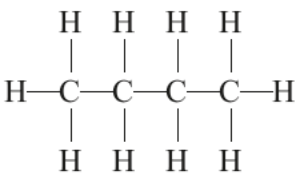
1 .....

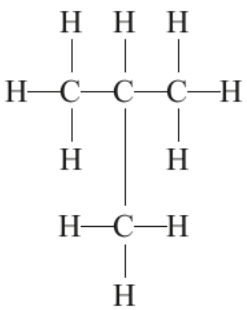
.....

2 .....

.....

(e) The displayed formulae below represent isomers.





Explain what isomers are.

(2)

.....

.....

.....

.....

(Total for Question 4 11 marks)